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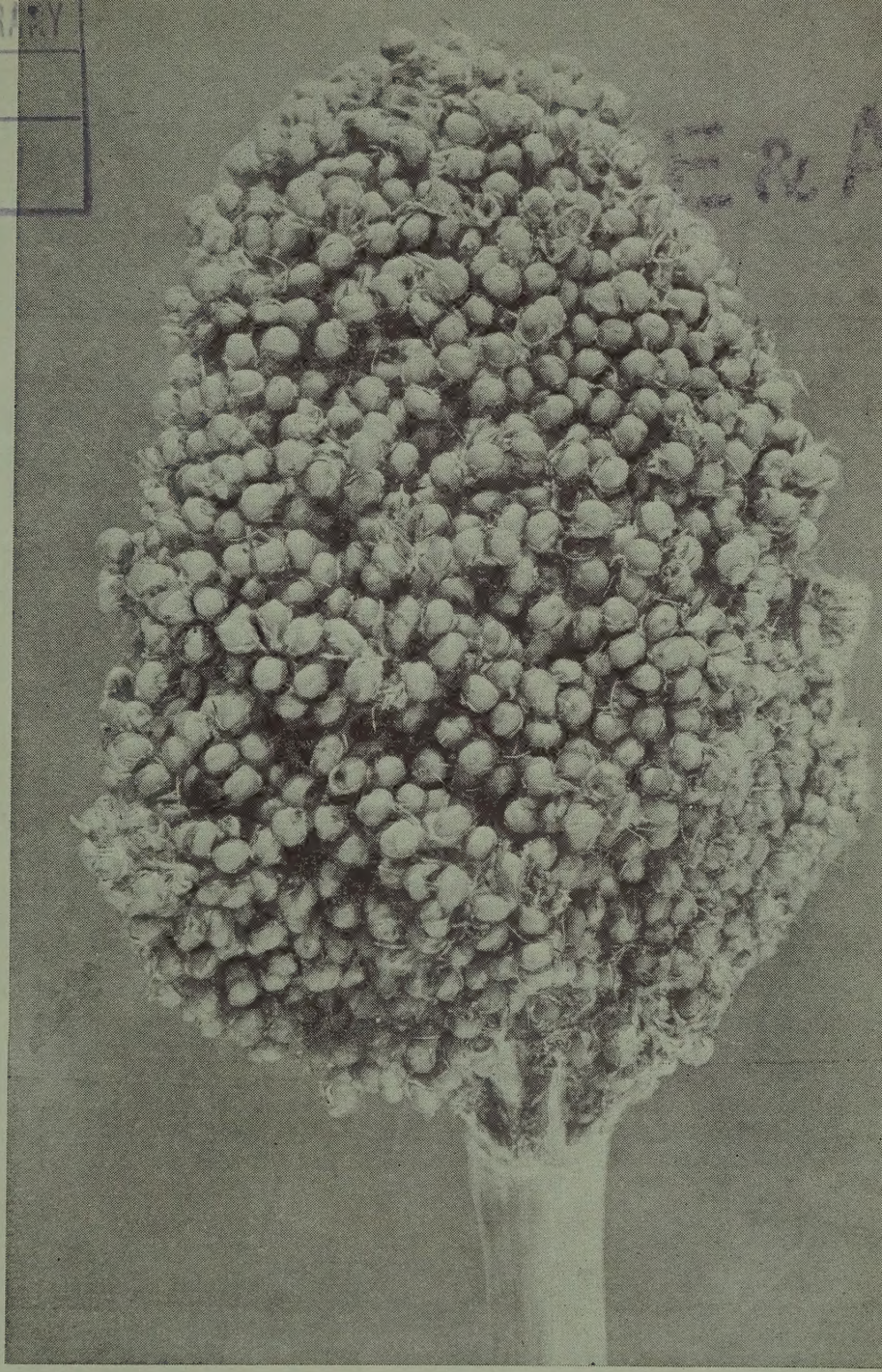

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Cover: Improved Variety of Jowar

[*Photo by P. R. R. Pillai*]

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Editorial

THIRD FIVE-YEAR PLAN

EVERYONE concerned with planning is now busy with preparation of Third Five-Year Plan. Number of Working Groups have been set up in the Centre as well as in the States. Reports of these Groups are being finalised and before doing so, mutual consultations are being held. So far as agricultural production is concerned, plans are being drawn up for increasing production of all commodities. With regard to food production, however, a target of 110 million tons is contemplated to be achieved by the end of the Third Five-Year Plan. This means increased production of 35 million tons during the Plan Period over the base year production of about 75 million tons.

The possibilities of achieving this target are being discussed in almost all the Groups connected with agriculture. While there has been almost an unanimity of opinion with regard to the achievement of this target from technological point of view, the possibilities of providing the wherewithals for achieving this target such as fertilisers, chemicals, personnel, loans, etc., are being debated.

The Ford Foundation Team on agricultural production has produced a report in which it has suggested that 110 million tons should be the minimum target if a 'crisis' is to be averted. The Team has given valuable suggestions, the most important being supply of fertilisers. The Nalgarh Committee on Agrilcultural Administration has suggested streamlining the Departmental Organisations if something has to be achieved in the field of agriculture. The Prime Minister and many others have said time and again agriculture should receive topmost priority in the Third Five-Year Plan.

While it is interesting to watch the results of the deliberations in the final shaping of the Third Five-Year Plan, we would like to stress again that it is possible to increase the agricultural production provided:

(1) The Farmers' requisites are made available at a reasonable rate as, where and when they are required. The credit facilities should be made available for purchasing his requirements.

(2) The Technical "Know How" is made available to the Farmers on the spot as and when required.

(3) The Producer is assured of a certain minimum price.

(4) Hard work is put in by all concerned.

Research Articles

A PRELIMINARY NOTE ON NaTA AS A WEEDICIDE

By Dr. M. Puttarudriah*

Introduction

The writer[1,2,3] while reporting the results of the preliminary tests with the selective and general weedicides on broad-leaved weeds as well as grasses, indicated the promising results obtained with Trichloroacetate, (T.C.A) in the form of NaTA as a specific weedicide on *Cynodon dactylon* Pers, the hariyali grass, a noxious weed in the cotton growing black soils. This note is a record of extended observations on the effect of this weedicide on hariyali, as well as the nut-grass (*Cyperus rotundus* L.) and wild garlic (*Oxalis corniculata* L.), the three problem weeds in Mysore.

Materials and Methods

Sodium trichloroacetate (NaTA), a white soft powder, is said to be very suitable for killing the grasses of all kinds. The powder dissolves easily in water; but on keeping for about six months it becomes small clumps, unfit for dusting. It was tested both by dusting the dry powder and also by spraying on the weed plants, at the rate of 20 lb. per acre per treatment, and repeated thrice with an interval of about two weeks. Therefore the total quantity of weedicide required per acre on grass and other weeds in these tests was about 60 lb. and the quantity of water used for dissolving, in the case of spray, was not an essential factor, as care was taken to evenly distribute the quantity on all the test area.

As regards spraying two types of plots measuring $6' \times 6'$ and 3 guntas respectively for hariyali; and plots of $6' \times 6'$ for nut-grass and wild garlic were selected; and weedicide sprayed at the rate of 20 lb. per acre per treatment during June–July. Three repetitions at fortnightly intervals were carried out in each case. Four tests for hariyali, two for nut-grass and two for wild garlic were conducted. The actual quantities of weedicide used were $1\frac{1}{2}$ lb. in 15 gallons of water for the three-gunta plot; and about 5 oz. in 3 gallons of water for the other

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plots per treatment. This worked out to about 200 gallons of the weedicide solution per acre.

In the first two tests conducted during the months of November–December, the chemical was used as dry dust at the above rate on three plots each measuring 11′×11′ with hariyali, nut-grass and wild garlic respectively. The powder was fresh and could be evenly dusted on the host weeds by means of a hand-duster.

Results

Dusting experiment.—The hariyali was found to be scorched on the fourth day and was dried up after a week. The plot was free from grass for three months. After some showers in the fourth month sprouting was seen here and there.

The effect on nut-grass was similar excepting that scorching was noticed after 24 hours.

The wild garlic was very susceptible to this weedicide and the treated plants drooped within a few hours and dried up completely in 3–4 days. But the relief was very temporary as fresh seedlings sprouted after one or two weeks.

Spraying experiments.—The observations revealed that scorching was noticed on hariyali and nut-grass on the fourth day, the blades of the latter turning slightly yellowish. These symptoms of damage became more and more pronounced gradually and there was drying here and there after a week. Complete drying of both hariyali and nut-grass was seen after about a month from the date of first treatment.

After two and half months, on receipt of a few showers the hariyali seeds that had dropped down began sprouting. These plots were again sprayed and the seedlings were killed. The chemical had killed the underground runners; but not the grass seeds as evident from the fact that no sprouting from runners was seen, whereas the seeds sprouted after a lapse of 2–3 months when rains were received.

There was not much of seed sprouting in the three gunta plot which was practically free from hariyali for nearly 10 months. But in the smaller plot when spraying was discontinued the grass *Chloris barbeta* SW. became well established. In the nut-grass plot also this type of grass invaded and no further observation regarding the lasting effect of the weedicide on this weed was possible.

Verma *et al.*,[4] while reviewing the progress of chemical weed control in India, have stated that the Bombay Department of Agriculture has reported (*Annual Report* 1950–51) that hariyali when

sprayed with 100 lb. of T.C.A. (Sodium trichloroacetate) in 400 gallons of water per acre did not regenerate at all when compared to hand-digging which showed 15–20 per cent. regeneration; and that Narayanan and Meenakshisundaram found T.C.A. even at high rates of 10 and 20 lb. per acre had only a very temporary scorching effect and that there was complete regeneration of hariyali within two weeks. T.C.A. was also found in Madras to be effective on the above-ground parts of nut-grass with no *injury* to the bulbs.

The above results agree more or less with that which has been found with sodium trichloroacetate in Mysore; but in Bombay the quantity of T.C.A. used per acre is much more and that in Madras is much less than the quantity used in Mysore tests; hence the variance in Madras. 60 lb. of this weedicide per acre in three applications appears to be the optimum quantity.

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"IMPROVED METHOD" OF JOWAR CULTIVATION

By F. B. Kurtkoti[1] and C. B. Divekar[2]

Introduction

Jowar (*Sorghum vulgare*) is the staple food of Karnatak and also provides fodder for the cattle. Various practices of jowar cultivation are prevalent in the tract as well as application of organic and inorganic manures in various degrees to the crop. A comprehensive experiment to find out an optimum manurial and spacing combination for the *kharif* jowar crop was taken up at the Agricultural Research Station, Dharwar, in 1956–57 and was continued for three years. The present paper presents the results obtained in the "Improved method" of jowar cultivation in the medium black soil over the "Cultivators' method".

Materials and Methods

The experiment consisted of the following two treatment combinations.

(*a*) *Improved method.*—A basic dose of farmyard manure at 5 cartloads per acre; Application of superphosphate at 20 lb. P_2O_5 per acre prior to sowing; Application of ammonium sulphate at 40 lb. N per acre in two doses, half while sowing jowar and the other half three weeks after sowing; jowar seeds drilled at 4 lb. seed per acre with rows spaced 24 in. apart.

(*b*) *Cultivators' method.*—A basic dose of farmyard manure at 5 cart loads per acre; jowar seeds drilled at 4 lb. seed per acre with rows spaced 15 in. apart.

The experiment was laid out as per ABBA method with 12 replications in 1955–56 and in the randomised block design with 12 replications in 1956–57 and 1957–58 seasons with 360 sq.ft. net area for each sub-plot.

Pure seed of jowar *var.* Nandyal was used in the experimentation. The cultural operations were carried out as per normal practice in the tract.

Height measurements of 10 plants picked at random in each sub-plot were recorded at two stages of the crop growth, once at the age

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of 60 to 70 days after sowing and second time 150 to 160 days, *i.e.*, at the time of harvest of the crop. This data has been collected for three years, *i.e.*, in 1955–56, 1956–57 and 1957–58. Quantitative characters such as measurements of thickness of stem between 4th and 5th node, number of leaves per plant, length of earhead, weight of earhead and weight of grains per earhead were recorded on 10 plants in each sub-plot. This data has been collected for two years, *i.e.*, 1956–57 and 1957–58 seasons.

Experimental Results

Grain and fodder yield of jowar in lb. per acre and its percentage increase over the cultivators' method are presented in Table I.

Table I

Grain and fodder yield of jowar in lb. per acre in the "Improved method" (A) and the "cultivators' method" (B) and the percentage increase over the cultivators' method from 1955–56 *to* 1957–58

		1955–56		1956–57		1957–58	
		A	B	A	B	A	B
Yield per acre	Grain	2757	2039	2919	2421	1995	1457
	Fodder	8046	7166	10886	8940	9480	7480
% increase over 'B'	Grain	35·2%		20·5%		36·9%	
	Fodder	17·3%		21·7%		26·7%	

Height measurements of 10 plants selected at random were recorded in each sub-plot as stated earlier and are furnished in Table II.

Table II

Average height of jowar plants in cm. in the "Improved method" and the "Cultivators' method" of jowar cultivation

(Figures are the averages of 120 readings)

Treatment	1955–56 No. of days after sowing		1956–57 No. of days after sowing		1957–58 No. of days after sowing	
	50	160	63	160	75	164
Improved method (A)	77·50	267·06	146·00	335·60	241·1	287·50
Cultivators' method (B)	67·50	240·03	118·25	317·50	192·3	237·00

The various other quantitative measurements as stated earlier were recorded on 10 plants in each sub-plot in 1956–57 and 1957–58 seasons. The average performance is furnished in Table III.

TABLE III

Miscellaneous crop characteristics of jowar in the "Improved method" and the "Cultivators' method" of jowar cultivation

Quantitative characters	1956–57		1957–58	
	A	B	A	B
1. No. of leaves per plant ..	12·4	11·8	13·2	11·7
2. Thickness of stem in cm. ..	5·1	4·9	5·09	4·04
3. Length of earhead in cm. ..	26·0	24·7	20·32	16·90
4. Weight of earhead in cm. ..	77·5	65·5	48·5	26·0
5. Weight of grains per earhead in gm.	63·0	53·4	38·5	20·5
6. Proportion of grain weight per earhead to weight of earhead (expressed in %)	81·3	81·5	79·3	79·0

(*a*) *Yield of jowar.*—The statistical analysis of the data for grain and fodder yield showed that the treatment A (Improved method) is significantly superior to the treatment B (Cultivators' method). It is seen that the improved method on an average produces 605 lb. more grain and 1,361 lb. more fodder per acre than that obtained in the cultivators' method. This additional yield was procured by incurring additional expenditure on fertilisers. Evaluation of the additional expenditure by considering the price of ammonium sulphate at Rs. 345 per ton and superphosphate at Rs. 240 per ton amounts to Rs. 27·30 as the cost of fertilisers and Rs. 3·20 as the cost of fertilisation per acre. Evaluating the additional produce at Rs. 10 per maund of grain and at Rs. 10 per 1,000 lb. of fodder works out to Rs. 87·31 per acre. This leaves a net profit of Rs. 56·81 per acre as the other items of cost of cultivation remain the same in both the methods.

(*b*) *Growth performance.*—A perusal of Table II shows that the height of the jowar plants in the "Improved method" (A) is more than that in the "Cultivators' method" (B). This increase in height seems to occur early and persists throughout the crop period.

Enhanced crop growth is further observed in the "Improved method" as is seen from Table III. The increase in the length of earhead, weight of earhead and the weight of grains per earhead possibly explain the higher grain yield obtained in the "Improved method". Similarly increase in the number of leaves, height of the plants at harvest and the thickness of the stem contribute to the higher fodder yield obtained in the "Improved method". However the "Improved method" does not appear to have influenced the setting of grains as is seen from the proportion of grain weight per earhead to weight of earhead.

Discussion

Chavan and Patil (1955 *a*) have observed, in trials with *bajri* (*Pennisetum typhoides*), a high response to nitrogen and phosphoric acid application in the presence of basal dose of farmyard manure. Sirur *et al.* (1955) have observed *kharif* jowar responding significantly to nitrogen, phosphorus and farmyard manure. In the present investigation the increase in the yield of *kharif* jowar in the "Improved method" confirms the findings of the above workers. As regards spacings, Chavan *et al.* (1955 *b*) did not observe significant difference in the yield of *rabi* jowar amongst the three spacings, *viz.*, 12 in., 15 in. and 18 in. tested. However, in the present study the wider spacing in the "Improved method" also appears to be one of the contributory factors towards the increased yields.

In the present investigation the "Improved method" which involves wider spacing between rows and application of nitrogen and phosphoric acid in addition to the normal farmyard manure gives on an average 605 lb. more grain and 1,361 lb. more fodder per acre. Besides the increase in yield so obtained meets the additional expenditure of fertilisers and fertilisation and leaves a clear net profit of Rs. 56·81 per acre.

Acknowledgements

The authors take this opportunity to express their thanks to Shri B. B. Yeligar, Deputy Director of Agriculture, Dharwar Division, Dharwar, and to Dr. H. R. Arakeri, Joint Director of Agriculture, Mysore State, Bangalore, for their guidance.

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A PRELIMINARY NOTE ON THE CONTROL OF RED-ANT (*SOLENOPSIS GEMINATA* FABR.) ON SOME OF THE VEGETABLE CROPS

By D. V. Murthy*

Introduction

The red-ant, *Solenopsis geminata* Fabr., is one of the most cosmopolitan species of insects, having been recorded practically in every country. Its importance in Agriculture has been three-fold: (1) Its carrying away of small seeds sown in fields, (2) Its fostering care towards noxious insects like mealy bugs for the sake of their honey-dew excretions and (3) Its habit of gnawing into plants and fruits. While a good deal of investigations have been carried out on the first two aspects of damage by *S. geminata*, there has not been extensive investigations on the third aspect, namely, its gnawing into plants and fruits. The following note briefly deals with the recent observations carried out on the importance of *S. geminata* in the vegetable gardens in Bangalore District and attempts made towards its control by soil insecticides.

Brief Review of Literature

While there has been extensive literature on the systematics and biological aspects of *Solenopsis*, in general, the papers dealing with its economic importance are comparatively few. Clark (1931) reports that in Texas in United States of America, *S. geminata* builds its nests at the bases of Citrus trees and feeds on the bark, often times causing death and is ranked first in importance as a pest of young Citrus. Smith (1936 *a*) working in Puerto Rico states that it is one of the most versatile ants known there and is said to attend on the pineapple mealy bug *Pseudococcus brevipes* Cockell. The same author (1936 *b*) points out that in Southern States of United States of America, *S. xyloni* is observed as gnawing into the buds of okra and althæa, the stems of dahlias and the base of the fruits of egg-plants. Irish Potato tubers are often scarified or gnawed into. Severin (1923) points out that *Solenopsis* is injurious to potatoes in California by tunneling stalks. On many occasions it is said to eat green vegetable matter and tender shoots. According to Lyle and Fortune (1948), *S. sayessima* var. *richteri* is

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very widespread and prevalent in Irish potato fields making it difficult to secure labour for harvest on account of its vicious stinging. In Mysore State, India, Seshagiri Rao (1956) has recorded damage to potato tubers by growing and tunneling of *S. geminata* Fabr.

General Observations

During the course of investigations in vegetable insect pests in Bangalore District, a number of complaints were received from Vegetable growers of wilting and drying up of plants like brinjal (*Solanum melongena*), potato (*Solanum tuberosum*), cabbage (*Brassica oleracea* var. *botrystis* L.) and bhendi (*Hibiscus esculentus*). External symptoms did not reveal the presence of casual agents such as tissue borers generally associated with drying up of plants. When the soil around the affected plants was removed it was found that the root system was severely pruned and in many cases even the tap root was found severely damaged. In a few instances, the shoot portion just above the ground level was also found damaged (photographs). When the affected plant was pulled out or the soil around removed, hundreds of workers of *S. geminata* would come out scattering about and inflicting vicious stings.

The attack by S. *geminata* on plants was invariably observed in patches and was found in close proximity with the underground nests. These colonies were found commonly located on the sides of water channels and bunds. The number of colonies (as roughly estimated by the entrance holes although colonies may contain more than one entrance holes) varied considerably, the maximum number observed being 28 in an area of one gunta (1/40 acre) in a vegetable patch in Doddaballapur. Infestation was invariably observed in red sandy loams.

The colonies were found generally within the first two to three feet of the soil depth.

Amongst the vegetable crops, potato and brinjal were the commonly affected crops. In case of potato the injury was found more to the tubers. The damage in the brinjal plots was however more apparent on account of the low stands and gappy nature of the transplanted seedlings. The following table gives an idea of the reduced stands of brinjal crop an account of *S. geminata* infestation in various localities.

In the initial stages of infestation yellowing was generally the first symptom observed followed by wilting. In very few cases some plants would recover following applications of fertilisers but such recoveries were extremely few. The affected plants would invariably dry up.

Table showing reduced stands of S. melongena *on account of* S. geminata *infestation*

Locality	Date	Number of seedlings originally planted in one gunta (33′ × 33′)	Number of seedlings last due to infestation
Nelamangala	27–10–1958	120	45
Doddaballapur	29–10–1958	70	18
Vijayapura	6– 8–1958	150	15
Sarakki	15– 8–1958	100	20
Kengeri	16– 7–1958	120	22
Doddaballapur	30– 4–1958	80	40

Control Measures

Control of soil insects used to be formerly a problem beset with difficulties, but with the advent of modern insecticides this problem has been greatly resolved. For purposes of control of *S. geminata* the following three insecticides were selected for preliminary trials.

(1) 20% Heptachlor E.C. used at 1 ounce in $1\frac{1}{4}$ gallons of water.

(2) 75% Chlordane E.C. used at 1 ounce in 4 gallons of water.

(3) Aldrex 30 E.C. used at 1 ounce in 2 gallons of water.

The method of application consisted of pouring in of the insecticidal material after dilution with water in the proportion mentioned above. After location of the entrance holes to the nests, the soil surrounding was slightly scooped in and the material poured in at roughly half a gallon. In case of infestations in the standing crops, affected plants were pulled out and the material applied at the place and also at the base of the surrounding unaffected plants.

Evaluation of the efficacy of the insecticidal treatments were rated on two basis, (*a*) the immediate effect of the insecticide on the winged adults and workers 4–6 hours after treatment and (*b*) the infestation of *S. geminata* on the succeeding crop. In case of longstanding crops like brinjal which remain in the fields sometime as long as a year, counts were also taken of the progress of further wilting and drying up of the plants after treatment at the time of next visit to the place.

Results

(*a*) *Immediate effect of the insecticides on the winged adults and workers of* S. geminata.

Insecticides tested	Number of living winged adults and workers, 4–6 hours after treatment
1. Heptachlor 20% E.C.	Nil
2. Chlordane 75% E.C.	Nil
3. Aldrex 30% E.C.	Nil

(*Remarks.*—Within almost 2 hours after treatment most of the winged adults and workers would wriggle out of the nests and die. As regards the immature forms the nests were dug out after 4–6 hours to find out the effect of the insecticide. *Localities*: Doddaballapur, Kengeri and Bangalore.)

(*b*) *Infestations of* S. geminata *in plots treated with insecticides—Heptachlor 20% E.C. and Chlordane 75% E.C.*

I Test *Locality*: Doddaballapur *Date of treatment*: 29–10–1958
Crop: Brinjal *Date of subsequent visit*: 27–12–1958

No. of ant nest entrance holes counted in Chlordane treated plots, on 29–10–1958 and 27–12–1958 in 1 gunta area	No. of ant nest entrance holes in Heptachlor treated plots on 29–10–1958 and 27–12–1958 in 1 gunta area	Control plots
12–2	22–Nil	14–16

Remarks.—Plots sown with *Artemesia.* No infestation or drying up observed in Chlordane and Heptachlor treated plots.

II Test *Locality*: Doddaballapur *Date of treatment*: 29–10–1958
Crop: Brinjal *Date of subsequent visit*: 27–12–1958

(*a*) No. of ant nest holes counted in Chlordane treated plots on 29–10–1958 and 27–12–1958	Control plots	No. of ant nest holes counted in Heptachlor treated plots on 29–10–1958 and 27–12–1958
18–6	12–12	14–Nil

(*b*) No. of potato plants found affected in Chlordane treated plots on 27–12–1958 in 1 gunta plot	Control plots	No. of potato plants found affected in Heptachlor treated plots on 27–12–1958 in 1 gunta plot	
12	20	Nil	

III TEST *Locality*: Kengeri *Date of treatment*: 16–7–1958
Crop: Newly planted Brinjal *Date of subsequent visit*: 17–8–1958

(*a*) No. of ant nest holes counted in Chlordane treated plots on 16–7–1958 and 17–8–1958	Control plot	No. of ant nest holes in Heptachlor treated plots on 16–7–1958 and 17–8–1958	No. of ant nest holes counted in Aldrex treated plots on 16–7–1958 and 17–8–1958
6–2	6–8	10–00	8–2
(*b*) No. of further infestations on brinjal crop on 17–8–1958			
4 more plants affected (Chlordane)	16 more plants (Control)	Nil (Heptchalor)	2 more plants found attacked (Aldrex)

IV TEST *Locality:* Kengeri *Date of treatment*: 16–7–1958
Crop: Old Brinjal crop *Date of subsequent visit*: 17–8–1958

(*a*) No. of ant nest holes counted in Chlordane treated plots on 16–7–1958 and 17–8–1958	No. of ant nest holes counted in Heptachlor treated on 16–7–1958 and 17–8–1958	No. of ant nest holes counted in Aldrex treated plots on 16–7–1958 and 7–8–1958
12–3	9–2	15–4
(*b*) No. of further infestations on brinjal crop on 17–8–1958 (Chlordane)	No. of further infestations on brinjal crop on 17–8–1958 (Heptachlor)	No. of further infestations on brinjal crop on 17–8–1958 (Aldrex)
Nil	Nil	Nil

Discussion and Conclusion

A perusal of the data show that *S. geminata* is quite a severe insect pest of certain vegetable crops, causing gappiness in the stand of plants and consequential reductions in yield. It is particularly severe on brinjal and potato crops. While it is difficult to correctly evaluate the performance of insecticides on a pest such as *S. geminata* which is not uniformly distributed in the soil, preliminary trials carried out with Heptachlor 20% E.C., Chlordane 75% E.C. and Aldrex 30% E.C. reveal that all the insecticides are effective against *S. geminata*, Heptachlor 20% E.C. proving slightly better than the other two in its performance. All the insecticides tested cause high mortality of both the winged and wingless adults and workers and the effect is fairly long lasting.

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Damage to Crop Plants by *Solenopsis geminata*

Fig. 1. Healthy and affected Potato tubers.

Fig. 2. A close-up view of Potato Stem cut by *S. geminata*.

Fig. 3. A close-up view of brinjal plant cut at the growing end by *S. geminata*.

Fig. 4. Tomato and Cabbage Plants drying up as a result of *S. geminata* attack.

Fig. 5. Healthy and affected Potato Plants.

Fig. 6. Brinjal plants drying up.

(Received: 3rd December 1958)

FIGS. 1–6

EFFECT OF NITROGEN AND PHOSPHORUS APPLICATION ON *KHARIF* JOWAR IN LIGHT RED AND MEDIUM BLACK SOILS OF NORTH KARNATAK

By S. V. Patil,[1] M. B. Tippannavar[2] and H. R. Arakeri[3]

Introduction

Jowar (*Andropogon sorghum*) is an important food and fodder crop in India. It is mainly grown in peninsular India in tracts receiving 20–40 in. rainfall. The area under Jowar crop in India is about 38·3 million acres, while in Mysore State it is 4 million acres and it ranks first in respect of crop area. Jowar is grown both in *Kharif* and *Rabi* seasons. *Kharif* Jowar in Mysore State is mainly grown in North Karnatak in areas receiving 25–30 in. rainfall. It is grown on different types of soil ranging from light red to deep black soils. In a rotational system, it is Jowar which generally receives an application of farmyard manure but the supply of farmyard manure is too inadequate to manure all the area sown under Jowar. The soils of North Mysore have been cropped since centruries and the soils where Jowar is grown though possessing high potential fertility, are however low in available nutrients. As such the average yield of crop is low as about 300–400 lb. per acre. With a view to study the possibility of increasing the yield with application of fertilisers, investigations were carried out at the Agricultural College Farm, Dharwar, on both light red and medium black soils and the details are presented in this paper.

Review of Literature

Vaidyanathan (1934) analysing the manurial experiments in India has stated that the response of nitrogen to Jowar in red soils is less than in black soils.

Das (1945) draws attention to the uncertain and erratic behaviour of superphosphate and indicates that its manurial value is enhanced when it is applied along with organic manures.

Stewart (1947), in surveying the soil fertility status of Indian soil with special reference to manuring, mentions that most of the soils are deficient in nitrogen and phosphorus, and further he reports that in

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many soils where phosphorus singly has little effect, a combination of nitrogen and phosphorus may be markedly superior to application of nitrogen alone.

Patil and Thippannanavar (1951) have reported that the yield of *kharif* Jowar is increased by 38% with application of 20 lb. of nitrogen at sowing, over a basal dose of 2½ tons of farmyard manure.

Pandya *et al.* (1955) have reported that the trials conducted at Surat, Jalgaon and Dharwar Farms from 1948–51 revealed a linear response to nitrogen application, while application of P_2O_5 did not show any response, but the application of a higher dose of nitrogen and 20 lb. of P_2O_5 has given good increase in yield.

Singh and Sahasrabudhe (1957), reporting the work done at Indore, state that with application of 20 lb. of nitrogen, the increase in yield was to the extent of 223 lb. of grain and 1,203 of fodder. The application of 20 lb. of P_2O_5 had no beneficial effect on the yield of grain, but increase of 293–535 pounds in fodder per acre was obtained.

Material and Methods

The experiment was carried out in 1950–51 and 1952–53 seasons on light red and medium black soils at the Agricultural College Farm, Dharwar. Some of the important physical constituents and chemical properties of the soils under experiment are as follows:

Particulars	Soil	
	Light red 0–9″	Medium black 0–12″
Physical		
1 Loss on ignition ..	7·60	11·18
2 Sand % ..	43·42	13·13
3 Silt % ..	14·50	18·62
4 Clay % ..	37·75	61·00
Chemical		
1 Total N % ..	0·0625	0·063
2 Available P_2O_5 mg./100 gm. ..	8·70	6·56
3 Available K_2O mg./100 gm. ..	14·85	16·70
4 pH ..	7·10	7·60

The experiment consisted of 3 levels of nitrogen (0, 15, 30 lb. per acre), 3 levels of P_2O_5 (0, 15, 30 lb. per acre) and 3 different timings of application of fertilisers (all at sowing, half at sowing and half after two months, and all two months after).

All the treatments received 5 cart-loads of farmyard Manure as a basal dose while nitrogen and phosphorus were given in the form of ammonium sulphate and single superphosphate respectively.

At the time of sowing the fertilisers were applied by spreading them uniformly on the surface of soils and then sowing was done immediately. The second dose was applied to the standing crop by spreading the fertilisers as a band on both sides of the rows and then inter-cultivation was done.

There were four replications and the gross plot and net plot size being $25 \times 11 \cdot 25$ ft. and $14 \cdot 75 \times 3 \cdot 75$ ft. respectively.

Results

Yield data.—The experiment was conducted during 1950–51 and 1952–53. The yield data along with critical difference are given in Tables I and II.

From Table I it can be seen that during 1950–51 with the application of 15 and 30 lb. of nitrogen, there was highly significant increase in yield of grain over control.

Split application of nitrogen has given 18% higher yield than that of application at sowing time. Applying all nitrogen at sowing has slightly increased the yield over that of applying two months later.

No significant increase in yield with application of phosphorus has been obtained.

During 1952–53 no significant differences in yield have been obtained either with application of nitrogen or with phosphorus. However, the application of 15 and 30 nitrogen has increased the yield by 6 and 8% respectively over control.

Further the results show that the split application is better than applying at one time.

The data presented in Table II show that in 1950–51, with application of 15 and 30 lb. of nitrogen, there was highly significant increase in yield of grain over control.

Split application of nitrogen has given higher yield than application of all quantity two months later. Application of all quantity at sowing has not given significant increase in yield over the application two months after sowing.

TABLE I

Average grain yield in pounds per acre for light red soil

(Average of 4 replications)

Time of application	Levels of phosphorus	Levels of nitrogen							
		1950–51				1952–53			
		N_0	N_1	N_2	Average	N_0	N_1	N_2	Average
A	P_0	1004	868	1112	994·7	1012	884	828	908
	P_1	810	1372	1048	1076·7	824	904	1296	1008
	P_2	1136	1094	952	1060·7	696	1016	1106	939·3
	Average ..	983·3	1111·3	1037·3		844	934·6	1076·6	
B	P_0	620	1356	1750	1242·0	972	846	988	935·3
	P_1	928	1192	1662	1260·7	1110	1144	1082	1112·0
	P_2	946	1140	1532	1206·0	982	1172	1116	1023·0
	Average ..	831·3	1229·3	1648		1021·3	1054	1028·6	
C	P_0	894	1020	1300	1104·7	1052	1226	820	1032·7
	P_1	902	1048	1354	1101·3	946	912	1060	972·7
	P_2	764	1200	976	980·0	916	922	1006	948·0
	Average ..	853·3	1122·6	1210·0		971·3	1020	962	
L.S.D. at 5% level for time of application			..				..		
L.S.D. at 5% and 1% level for nitrogen			157·2 202·5				..		
L.S.D. at 5% level for body for same time and different nitrogen			272·3				..		
L.S.D. at 5% level for body for same nitrogen and different time			334·2				..		

TABLE II

Average yield of grain in pounds per acre in medium black soil
(Average of 4 replications)

Time of application	Level of phosphorus	Level of nitrogen							
		1950-51				1952-53			
		N_0	N_1	N_2	Average	N_0	N_1	N_2	Average
A	P_0	746	1272	1504	1180·0	1312	1504	1430	1415·3
	P_1	816	1172	1980	1329·3	1034	1514	1248	1265·3
	P_2	1046	1350	1602	1332·7	1112	1380	1798	1430·0
	Average ..	875·3	1264·7	1695·3	..	1152·7	1466	1492	..
B	P_0	1040	1344	1408	1264	792	1476	1480	1309·3
	P_1	1016	1498	1856	1456·7	1364	1458	1808	1543·3
	P_2	1236	1252	1738	1412·0	1006	1744	1882	1544·0
	Average ..	1097·3	1368·0	1667·3	..	1114	1559·3	1723·3	..
C	P_0	852	1242	1564	1219·3	1446	908	1186	1180·0
	P_1	778	1224	1112	1038·0	1332	1312	992	1212·0
	P_2	748	1394	1232	1124·7	1292	1480	1490	1420·7
	Average ..	792·7	1286·7	1302·7	..	1356·7	1233·3	1222·7	..

L S.D. at 5% level for time of application ..	216·8	..
L.S.D. at 5% ..	136·64	215·6
L.S.D. at 1% for nitrogen ..	175·98	..
L.S.D. at 5% level for body same time and different nitrogen	236·4	361·98
L.S.D. at 5% level for body for same nitrogen and different time	262·4	378·95

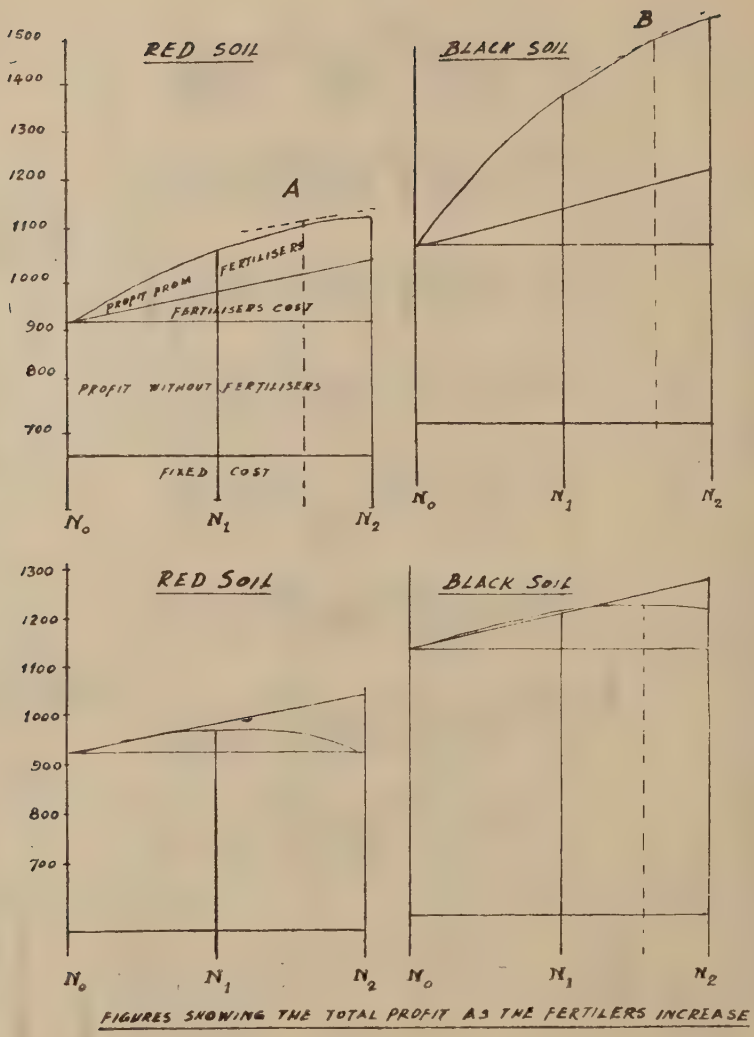

FIG. 1

No significant response to application of phosphorus was obtained. On the contrary application of all phosphorus either at sowing or two months later had a depressing effect on the yield of grain.

During 1952–53 there was significant increase in yield of grain with the application of nitrogen over no application of fertiliser. However the levels of nitrogen did not show significant difference in grain yield, although 30 lb. of nitrogen application has given 11% higher yield than that of 15 lb. of nitrogen application.

During this year also split application has given significantly higher yield than the application in one dose two months later. But

there was no significant difference between those applied in one dose at sowing and two months later, although the application at sowing has given 8% higher yield than application two months later.

In 1952–53 also no significant response to the application of phosphorus has been obtained.

Discussion

Nitrogen application to *kharif* Jowar in both the soils has enhanced the yield of Jowar. The percentage of increase has been 49·5 and 72·1 in light red and medium black soils respectively over the application of 5 cart-loads of farmyard manure.

Though the time of application of fertilisers to crops is not significant but split application has been found to be better than applying all in one dose either at sowing or two months later. This may be because of steady supply of nitrogen right from the start of plant growth. Some quantities of nitrogen applied at sowing, usually known as starter application, may help to increase the concentration of nitrogen in young seedlings and which may in turn enhances yield due to increased leaf size and quick emergence of leaves.

Applying all nitrogen at sowing time may not be required in initial stage and extra quantity may be leached due to heavy rains in July and August and at later stage plants may not get adequate supply of nitrogen to keep up rapid rate of growth. Similarly applying all nitrogen after two months deprives the crop of adequate supply of nitrogen in initial stage. The split application has been, therefore, found to be distinctly advantageous over application done all in one dose.

Applying all nitrogen at sowing has been found to increase the fodder yield significantly over the split as well as two months later in both the soils. The high quantity of nitrogen applied at sowing has helped to increase the vegetative growth of the plant.

The application of phosphorus alone in both the soils in one dose to *kharif* Jowar has depressed the yield to an extent of 12·2% and 8·7% in light red and medium black soils respectively. This may be due to the high availability of P_2O_5 in the soils and which may lower the uptake of nitrogen as pointed by Arakeri *et al.* (1957) in case of wheat. But split application of phosphorus has helped to increase the yield to an extent of 7% and 9% in light red and medium black soils respectively. This may be because small quantity at a time may help in balanced nutrition of the crop.

The combined application of nitrogen and phosphorus, in split form, has given about 16% and 37·5% higher grain yield and 29 and

40% increase in fodder yield over the application of nitrogen only in light red and medium black soils respectively.

(1) *Economics.*—Though the added doses of fertilisers give increasing yields, it is necessary to work out the economics of fertiliser application. In working out the economics of these applications the cash return in rupees per rupee spent on fertiliser is found to be a good criterion. The following table shows the cash return (in rupees) per rupee spent on fertilisers.

Cash return (in rupees) per rupee spent on fertilisers

Time of application	Levels of phosphorus	Levels of Nitrogen					
		Light red soil			Medium black soil		
		N_0	N_1	N_2	N_0	N_1	N_2
A	P_0	..	1·47	0·91	..	2·81	2·12
	P_1	—0·61	1·70	1·84	—1·41	2·30	2·85
	P_2	—0·33	0·93	0·83	0·43	1·77	2·50
B	P_0	..	2·83	2·56	..	2·91	2·43
	P_1	1·08	1·56	1·96	2·41	2·15	2·84
	P_2	0·93	1·15	1·19	0·87	1·82	2·28
C	P_0	..	2·32	1·08	..	—0·24	2·06
	P_1	0·95	0·34	1·00	—1·34	0·65	—0·31
	P_2	—1·00	0·70	0·19	—0·66	1·10	0·70

It is clear that more cash returns are obtained in case of split application in both the soils. Further, the figures indicate that maximum cash return of Rs. 2·83 and Rs. 2·91 are obtained with application of 15 lb. nitrogen in two doses in lightred and medium black soils respectively. The cash return decreases with increasing doses of nitrogen as the response falls off rapidly. This confirms the observations made by Raheja (1957) for Jowar.

The application of phosphorus alone has resulted in loss ranging from Rs. 0·33 to Re. 1·00 in red soil and Rs. 0·24 to Re. 1·41 in case of medium black soil per rupee spent on fertiliser. The loss is more with application of P_2O_5 at sowing time in both the soils. But it has given cash returns of Rs. 1·96 and Rs. 2·84 in red and black soils respectively when applied with 30 lb. nitrogen in split application. Application of phosphorus, it therefore appears, would be only economical when applied along with nitrogen.

Profits with fertiliser applications are also determined by the difference between costs and returns. Figure 1 will give idea of how the costs and returns compare when the dose of fertiliser is increased. In the illustration given the cost of production on preparatory tillage, sowing, inter-tillage, etc., remain stationary as it is not influenced by the application of fertilisers.

It is seen from the illustration that the profit increases as the fertiliser application is increased to a certain point and then begins to fall off as additional fertiliser is added. Points 'A' and 'B' on the curve denote the peaks in profits. These points of maximum profit per acre occur where the distance between the cost line and the yield curve is greatest, and they just touch the dotted line drawn parallel to the fertiliser cost line. In case of red soil as shown in the illustration the maximum profit occurs at 22 lb. nitrogen and 15 lb. phosphorus application while it occurs at 22 lb. nitrogen and 22 lb. P_2O_5 in medium black soil. However it is further seen that the yields per acre continue to increase above this point of maximum profit but the cost of fertiliser increaes faster than the returns and hence the profits are reduced. A similar illustration has been given by Hanway and Benhet (1957) for fertiliser application to maize.

Summary

The results of experiments carried out indicate that the yield of *kharif* Jowar both in light red soil and medium black soil could be considerably increased by careful programme of nitrogen and phosphorus fertiliser applications.

Fertilisers should be applied in divided doses, rather than in one single application.

The grain yield can be increased to the extent of about 72% and 82% in red and medium black soils respectively with the application of nitrogen and phosphorus.

Application of 15 pound nitrogen in two doses is found economical for *kharif* Jowar. With this dose about 3 rupees cash return can be obtained for every rupee spent on fertiliser.

The yield can be further increased by supplying phosphorus along with nitrogen but the cash return for every rupee spent on fertiliser decreases.

Maximum profit can be obtained with 22 lb. nitrogen and 15 lb. P_2O_5 application in light red soil while with 22 lb. nitrogen and 22 lb. phosphorus in medium black soil.

It is more profitable to apply fertilisers to medium black soil than to red soil.

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OPTIMUM WATER AND MANURIAL REQUIREMENTS OF SUGARCANE ON GHATAPRABHA LEFT BANK CANAL

By K. R. Kulkarni*

I. Introduction

Water requirement of sugarcane is one of the highly disputed subjects, amongst sugarcane growers, sugar factories and research workers. The general concept that higher yields of sugarcane are obtained by profuse irrigation, does not appear to hold good under careful experimentation. Under the Ghataprabha Water Requirement Scheme, Arabhavi, research work is being carried out since 1954, with the object of finding out optimum water and manurial requirement of sugarcane.

The sugarcane growers on the Gokak Canal apply about 10–20 cart-loads of farmyard manure per acre depending upon its availability and also approximately 100 lb. of nitrogen top dressing. The top dressing is usually applied in three doses, but, it is not properly balanced with regard to the source of nitrogen, *i.e.*, ammonium sulphate and cake proportion. Water is given indiscriminately, with the presumption that higher watering produces higher yields of sugarcane and jaggery. The average yield may be taken to be about 30 tons per acre or 90–100 Bengali maunds of jaggery per acre.

II. Materials and Methods

An experiment was laid out with 3 levels of irrigations, *viz.*,

(1) As and when required — Flooding the furrow and measurement
(2) 95″ for 12 months — Inclusive of rainfall.
(3) 115–A″ for 12 months — do.

and 3 levels of nitrogenous top dressings, *viz.*,

(1) 100 lb. of N per acre; (2) 150 lb. N per acre; (3) 200 lb. N per acre.

20 cart-loads of F.Y.M. were applied as a uniform basal dose. The experiment was conducted for a period of 4 years on Plant-Cane, variety Co. 419.

The design of the trial was randomised blocks, replicated 4 time.

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III. Results

The yield of stripped sugarcane is presented in Table I.

Table I

Average of 4 replications *Yields in tons per acre*

Year	Water			Nitrogen			C.D.
	Judgement* 120 A′	95–A″	115–A″	100 lb.	150 lb.	200 lb.	
1954–55 ..	41·83	44·29	45·20	43·02	43·27	45·03	3·04
1955–56 ..	40·83	38·39	37·68	34·83	38·60	43·47	1·18
1956–57 ..	40·74	39·18	38·99	36·74	39·89	42·27	3·28
1957–58 ..	38·18	37·60	39·63	33·48	39·46	42·47	6·22
Average ..	40·39	39·87	40·38	37·02	40·31	43·31	..

* As and when required.

IV. Discussion

On the average of 4 years results, it is found that by applying 200 lb. nitrogen top dressing per acre, the yield of sugarcane was increased by 6·29 tons per acre, as compared to 100 lb. nitrogen per acre. Valued at Rs. 40 per ton, the increased out-turn would be Rs. 250 per acre whereas the additional cost in applying 100 lb. nitrogen more would be approximately Rs. 125 per acre. Thus, there is a net profit of Rs. 125 per acre.

There was no significant difference in yields noted due to the different water levels tried in the experiment. In general, 115 acre inches per acre may be taken to be the optimum water requirement of sugarcane crop for a period of 12 months.

V. Conclusions and Recommendations

From the above data and discussions, the following manurial schedule may be given as optimum for the tract.

Basal F.Y.M. or Compost: 20 cart-loads per acre.

Top dressing 200 lb. nitrogen in 1: 2 proportion of Sulphate of ammonia and groundnut cake in 4 doses as detailed in Table II.

Regarding water doses, 115 acre inches may be taken to be the average water requirement, inclusive of rainfall. Thus, if 25″ is the rainfall during the year, the actual water to be given by irrigation would

TABLE II

Time of application	Sulphate of ammonia in lb. per acre	Groundnut cake in lb. per acre
1. At planting	100	Nil
2. 8 weeks	65	1000
3. 16 weeks	100	Nil
4. Final earthing	65	1000
TOTAL ..	330	2000

be 90″. Interval between irrigations may vary from 10–12 days depending upon season, soil type and availability of water. In the above experiment. there were on average 27 irrigation turns during the life of the crop. This distribution of water may be, in brief, stated in Table III

TABLE III

Period	Rate of Irrigation in A″ per turn	Remarks
1½ to 2 months ..	2·50	Germination stage
Up to middle of October ..	3·00	..
1 month from middle of October–November	4·00	Flowering stage
Up to harvest ..	3·00	..

The above would be general recommendation, subject to variation according to the seasonal conditions and soil types. However, the total quantity of water consumed by the crop would remain unchanged.

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A PRELIMINARY NOTE ON IMPROVEMENT OF RAGI (*ELEUSINE CORACANA* GAERTN)

By C. H. Lakshmanaiah*

Introduction

Mysore is the premier ragi-growing State in India and the total area under this crop is about 19,14,000 acres. The annual production of grain is about 7½ lakh tons and forms about 35% of the total production in India.

Work on ragi improvment was initiated in Mysore as early as 1913. Some improved strains like K-22, K-1, ES-11 and RO-786 were evolved and are under general cultivation. But, after having served sufficiently under the conditions then prevailing, these varieties are found to be not in tune with the present conditions with regards to rainfall, availability of irrigation facilities, crop rotation, etc.

After a lapse of some years, work on ragi improvement was resumed in the year 1950 at the Agricultural Research Station, Mandya. Since then the possibilities of evolving better economic types through hybridisation suitable both for dry and wet land cultivation are being explored. Experiments are being conducted to find out suitable spacing and manurial schedules for different varieties. The following is a brief note on the work done so far at the Agricultural Research Station, Mandya, and further details will be published in due course.

I. Breeding Work

(*a*) *Irrigated Ragi.*—Bulk of ragi cultivation depends upon monsoon rains. This dependency upon rainfall is being much reduced after the advent of the new irrigation projects and larger areas are now coming under irrigated ragi.

Irrigated ragi is generally cultivated during summer. On account of scarcity of water and short period of growth during this season, varieties with early and even maturity, and high vigour are preferable to late maturing types. Some of the local irrigated ragi called "Gidda Ragi", though early, are poor yielders and hence are not suitable for economical cultivation.

To evolve types with the above-mentioned qualities breeding work was taken up in the year 1950 and as a result of this attempt "Aruna"

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was isolated in the year 1955 and is becoming popular in many of the irrigated tracts on account of its superior quality. It is an early variety with a duration of 105 days from sowing to harvest. Since it has got uniform maturity, about 90% of the earheads can be gathered during the initial cutting itself. It is cosmopoliton in its seasonal adaptability and can be cultivated under irrigation both during summer and monsoon seasons. It is proportionately high yielding and gives about 8 to 10 pallas of grain (1,600 to 2,000 lb.) under ordinary cultivation. With an idea of synthesizing still more high yielding types than ARUNA, hybridisation work was taken up subsequently. ARUNA, K-1 and CO-1 were used as parents for their good agronomic basis and two more new strains, *viz.*, UDAYA and PURNA, have been isolated from these combinations and about 150 cultures with greater potentialities are still under observation. The following is a brief description of these two strains.

UDAYA (20–13–27): This is a cross between ARUNA and K-1 and has been bred through 3rd generation. A total number of 26 selections were made from this combination and two strains, *viz.*, 20–13–24, a green recessive and 20–13–27, a purple dominant, were isolated from this batch of selections for their superior qualities. After critical tests for yield, strain No. 20–13–27 has proved to be better than K-1 and strain No. 20–13–24. This promising strain has now been named "UDAYA". The following are the comparative yields of UDAYA obtained during the yield trials:

TABLE I

Yield in lb.

Variety	1957 Summer	1957 Monsoon	1958 Summer	Average yield	% of K–1	Duration in days	Seasonal adaptability
K-1 ..	1361	2189	1704	1751	100	130	April-May
20–13–27 (UDAYA)	2513	2189	2424	2377	136	105	All seasons except Oct. and Nov.
20–13–24 ..	2450	2475	2008	2311	132	105	do.

As seen in Table I UDAYA has given 36% more yield than its parent K-1 in addition to its other improved charactors like earliness and even maturity.

UDAYA grows to a height of 3–3½ ft. with a tillering capacity of 3–4 per plant. The leaves are dark green in colour and hairy on the lower surface and leaf-sheath and flare away from the stem when mature.

Variety	Vigour	Height	Tillering	Earhead	Maturity
K–1	.. Medium	3′ –3½′	Moderate	Green, incurved	Uneven
20–13–27 (UDAYA)	Good	3′ –3½′	,,	Purple, open	Even
20–13–24	.. Poor	2¾′–3′	,,	Green, incurved	,,

The earhead is of open type and the fingers are 2½–3 in. long with rachis brittle when dry. Loss occurs due to breakage of fingers if harvest is delayed. The number of fingers in an earhead varies from 8–14. The purple pigmentation is intensified in the regions like glumes, basal ring, junction and nodal band. The open earhead shape distinguishes UDAYA from its 'top-curving parent ARUNA. It is early and the duration varies from 100–105 days. It is perfectly uniform in maturity and about more than 95% of the earheads can be gathered at the initial cutting itself whereas the other irrigated types require more than two cuttings. It has got wide range of seasonal adaptability and can be raised all through the year except during the months of October and November. This cosmopolitan character makes UDAYA highly suitable for rotation with sugarcane cultivation in the Visvesvaraya Canal Area. On account of its early maturity it is better suited for summer cultivation and a green manure crop can also be raised after ragi crop before transplanting monsoon paddy.

Some specific agronomic practices should be adopted for UDAYA. Healthy and vigorous seedlings should be raised and the seedlings should be 6–9 in. in height and should not be more than 25 days old. A closer spacing of 10 in. × 4–5 in. should be given and the fields adequentely fertilised in the proportion of 30 N + 20 P + 30 K. Timely planting, closer spacing and early manuring are the important agronomic practices necessary to obtain higher yields from UDAYA.

PURNA (24–26–24): This is a cross between ARUNA and K-1. 15 selections were made from this combination out of which two strains, *viz.*, 24–26–10, a green recessive and 24–26–24, a purple dominant, were isolated for their superior qualities. After critical tests for yield, etc., strain No. 24–26–24 has proved to be superior to both ARUNA and the other strain and it has been named as "PURNA". The following are the results obtained during the yield trials.

TABLE II

Yield in lb.

Variety	1957 Summer	1957 Monsoon	1958 Summer	Average yield	% of ARUNA	Duration days	Seasonal adaptability
ARUNA ..	2062	1713	1448	1741	100	105	All season except Oct. and Nov.
24–26–10 ..	2791	2299	1576	2222	129	105	do.
24–26–24 (PURNA)	2995	2343	1944	2427	140	105	do.

As seen in Table II PURNA has given 40% more than its parent ARUNA and its average performance in the bulk cultivation is about 2,600 lb. per acre.

Variety	Vigour	Height	Tillering	Earhead	Maturity
ARUNA ..	Medium	2′–3′	Very poor	Purple	Very even
24–26–10 ..	,,	2′–3′	Moderate	Green, top curving	,,
24–26–24 ..	High	$2\frac{1}{4}$′–$3\frac{1}{2}$′	,,	Dilute purple, top curving	,,

PURNA grows to a height of $2\frac{1}{4}$–$3\frac{1}{2}$ ft. and tillers moderately. Stem is rather thin with a dilute purple band at the node and does not break like ARUNA when dry. Leaves are green as against the dark green leaves of ARUNA and UDAYA, and does not flare away from the stem. They are narrow, closely set at the base and hairy at the lower surface and the leaf-sheath.

Though it is rather difficult to distinguish PURNA from ARUNA and UDAYA after the milky stage it is easily marked out from these two purple types from the position of leaves even in the later stages when the purple colour fades away. Earhead is purple in colour with top curving. The rachis remains soft and does not break even when there is some delay in harvest. Non-shedding is another economic character that distinguishes PURNA from ARUNA and UDAYA. The number of fingers in an earhead varies from 6–16, 9 and 10 being quite common. It is perfectly uniform in maturity and more than 90% of the earheads can be gathered in the initial cutting itself. The seasonal

adaptability, duration and the agronomic practices are similar to those of ARUNA and UDAYA. The following are the chief distinguishing charactors of ARUNA, UDAYA and PURNA.

Strains	Colour	Position of leaves	Earhead shape	Stem and Rachis
ARUNA ..	Purple	Flares away when mature	Top-curving	Brittle when dry, shedding of grain if harvest delayed
UDAYA ..	Purple	Flares away when mature	Open	Brittle when dry, sheeding of grain if harvest delayed
PURNA ..	Dilute purple	Does not flare away when mature	Top-curving	Soft even when dry. Non-shedding of grain

(*b*) *Dry land Ragi.*—The area under dry land ragi is decidedly larger than that of irrigated ragi with varied climatic conditions and seasons. There are dry land zones with a rainfall of below 25 in. and zones with a rainfall of above 35–40 in. Similarly dry land ragi has got two seasons, *viz.*, *hain* and *kar*. This varied climatic conditions of dry land tracts require varieties with different duration, drought and pest resistance. It is found that varieties that are neither too early nor too late, and with neither too compact nor too long open earheads are suitable for general cultivation. Mid-early and semi-compact varieties with a wide range of seasonal adaptability are preferable to the above-mentioned types. To evolve such improved strains of dry land ragi, hybridisation work was taken up along with that of irrigated ragi in the year 1950. Crosses were effected between H-22 and H-1 with an idea of evolving mid-early and semi-compact types with better seasonal adaptability. About 120 selections were made from these combinations and the following 6 strains are proving to be promising and are under trials.

II. AGRONOMIC EXPERIMENTS

(*a*) *Spacing for early maturing types of irrigated ragi.*—Proper spacing for different types of irrigated ragi is an important agronomic practice that countributes to higher yields. One and the same spacing cannot hold good both for tillering and non-tillering varieties. Closer

spacing for non-tillering types and larger spacing for tillering types is the commonly adopted cultural practice. In many cases lower yields are obtained through the neglect of these practices. To find out the optimum spacing schedule for ARUNA which is an early maturing and non-tillering irrigated ragi an experiment was taken up.

The experiment was in randomised blocks with 4 treatments and 6 replications. There was no definite spacing in the control plots whereas the experimental plots had three spacings of 10 in. × 4 in.; 10 in × 5 in. and 10 in. × 6 in. The following are the results of the experiment in 1957 and 1958.

TABLE III

Yield in lb.

Treatments	1957	1958	Average	% of control	Weed control
1. Control ..	2050	1388	1719	100	Line weeding required
2. 10″×4″ ..	2503	2000	2251	131	No line weeding
3. 10″×5″ ..	3083	2000	2541	148	do.
4. 10″×6″ ..	2318	1777	2047	119	Line weeding required

C.D. per acre = 9·217 lb.; S.E. = 0·3.

From Table III it is seen that the spacing of 10 in. × 5 in. has given the highest yields. For the sake of convenience in bulk planting a common spacing of 10 in. × 4–5 in. can be adopted in the absence of specific implements to mark out correct spacing.

(*b*) *N.P.K. Trial on Aruna.*—To evolve a suitable manurial schedule for ARUNA ragi an N.P.K. trial was conducted. The experiment was in randomised blocks with 6 replications and 4 treatments, *viz.*,

(i) Control (without fertilizers);

(ii) 15 N + 10 P + 15 K;

(iii) 30N + 20P + 30 K;

(iv) 45N + 30P + 45 K.

A basal dose of 3,000 lb. of farmyard manure was applied before transplanting to all plots. The fertilisers were powdered, mixed well and drilled into the soil along with the furrows opened for transplanting the seedlings. Care was taken to see that the manurial mixture was applied evenly.

Marked differences could be seen between one treatment and another with regard to growth, maturity, tillering capacity, etc. The fertilised plots matured earlier by about 5 days.

It is seen from Table IV that ARUNA can withstand the highest level of N.P.K., *i.e.*, 45 N+30 P+45 K without any lodging.

TABLE IV

Yield in lb.

Treatments	1957	1958	Average	% of Control	Maturity days
1. Control .. (No N.P.K.)	1475	693	1084	100	105
2. 15 N+10 P+15 K	1541	933	1237	114	100
3. 30 N+20 P+30 K	1715	1200	1457	135	100
4. 45 N+30 P+45 N	1987	1406	1696	156	100

C.D. per acre = 94 lb.; S.E. = 2·3.

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General and Review Articles

A NOTE OF THE AMERICAN COTTON IMPROVEMENT WORKS AT GADAG (DHARWAR DISTRICT)

Part I

By K. G. Kottur*

Introduction

In Dharwar District *G. herbaceum* cotton was being grown since a long time. England had started importing this cotton by the beginning of the 18th century. By the end of the 18th century, however, America had started exporting her cotton to England. Due to the superior qualities of the American Cotton, the British Cotton trade with India was affected and attempts were made to improve the situation. In 1818 the East India Company Government, in India, started distributing exotic cotton seeds in Dharwar Area for trials in the Cotton Farms at Navalgunda, Morab, and Dharwar. Trials were conducted upto 1836 and the results were reported to be doubtful. In 1842, the Collector of Dharwar, on his own initiative, gave a second trial to this material and demonstrated the possibilities of growing the American cottons in these parts. The following note deals with trials conducted with *Rabi* American cottons in Gadag.

The Cotton Tract

This subdivides into:

(i) The *rabi* American Cotton area, in the *desh* included in Gadag and Ron Talukas of Dharwar District; and

(ii) the *kharif* American Cotton area in the transition belt included in the Ranebennur, Haveri, Hirekerur, Byadgi Talukas of Dharwar District.

The *rabi* American area in the *desh* is more or less an open plane liable to drought and produces good crops of jowar, cotton and oil-seeds in normal years. Soil is derived from a mixture of decomposed rocks of all sorts found scattered in the tract. The rocks are chiefly granite and belong to gneiss formation.

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The soils are usually classified into:

(i) Red; (ii) Black; (iii) Brown.

TABLE I

Chemical analysis of soils

Items	Gadag	
	Red %	Black %
Loss on ignition	5·00	6·08
Sand and silicate	79·53	71·77
Iron and alumina	13·05	12·55
Lime	0·59	2·61
Magnesia	0·55	0·45
Potash	0·27	0·42
P_2O_5	0·08	0·08
Nitrogen	0·064	0·022

The red soils are shallow, contain more sand and hence quickly drained. Deep black soils are retentive. Soil erosion is common in black soils.

CLIMATE

The climate of Ron, Gadag and Navalgund is a monsoonal type with influence of both the South-West and North-East Monsoons.

(i) *Pre-monsoon.*—April to June is characterised by dry hot days. Usually there are one or two rainy days in each of April and May months. Rain is thundery type. Hailstorms are rare but not absent. Sometime there is thin cloudiness in the sky. Strong westerly winds sometimes with a velocity of 20–25 miles per hour are not unusual. Dust-devils are also not uncommon. During this period preparatory tillage for jowar and cotton is done.

(ii) *Monsoon* (June to September).—Gadag receives South-West Monsoon starting from about the first fortnight of June. Rains are usually non-showery type. Usually $\frac{1}{3}$ of the annual rainfall is received during this period. From the agricultural point of view this is not a very reliable rain. During this period temperature fluctuations are

not very great. The average humidity is not high enough to call it a moist season. During this period the sowing of groundnut and jowar is done. Preparatory tillage for cotton is also done.

(iii) *Post-monsoon* (September to November).—The monsoon starts withdrawing from the Bombay coast by about the 10th of September. About this time the post-monsoon showers are received. These rains are really substantial and dependable for cotton crop. Thunder showers are common in this period. From November onwards the rain ceases and the winter sets in. This lasts upto about 15th February. The climate in the winter is dry and cold. Sometimes light clouds are seen. Easterly winds which are dry and cause a *desiccating* effect are common. About this time the cotton suffers from red leaf blight.

The Research Work Done on Cotton Improvement

The introduced exotic cottons consisted of mainly the New Orleans types. There were also (i) *Georgian*, (ii) *Upland Georgian*, (iii) *Lousiana*, (iv) *Bourbon*, (v) *Paranambuceo*, (vi) *Egyptian* and (vii) *Sea Island* type in some small proportions. Mixture and hybridisation of these cottons had taken place during the course of acclimatisation and a lot of variability in the types was observed. With the establishment of Gadag Research Farm, in 1908, botanical improvement work was taken up. The branching habit, hairiness of stem and leaves, colour of petals, colour of pollen grain, boll shape and size, yield, ginning percentage, staple and resistance to red-leaf blight were studied. As a result a selection of the *Upland* type cotton was isolated with superior qualities and was released for cultivation in 1918, under the name *Gadag I.*

Table II

Performance of Gadag I vs. *Dharwar-American Bulk* (1915 *to* 1919)

Varieties	Kapas yield	Lint yield	Ginning	Remarks
	lb.	lb.	%	
Gadag I ..	436	149	34·2	26% more clean and getting Rs. 20/- more per candy
D-American ..	364	118	29·6	

Soon after the release of *Gadag I* cotton the Research Substation at Gadag was closed down and the material was shifted to Dharwar.

Several crosses were made and studied at Dharwar uptil 1942. In 1942 a scheme for improvement of the Dharwar-American cotton was started with the financial and technical help of the Indian Central Cotton Committee, at Gadag, in the heart of the tract, and the promising material from all places were tried. A secondary selection, (9–3) from the cross *Gadag I* × Co_2 (from Dharwar), definitely established its superiority in the various trials and mill tests and was recommended for cultivation under the name *Laxmi* in 1950.

Laxmi cotton was released for general cultivation in 1950. The original 3½ lakhs of acres of the tract extends to over 6½ lakhs of acres at present.

TABLE III

Agronomic and economic characters of Laxmi *and* Gadag I

Sl. No.	Particulars	*Laxmi*	*Gadag I*	Remarks
1	History ..	A synthetic selection from the cross *Gadag I* × Co_2	A unit plant selection from the local American cotton	
2	No. of monopodia ..	1·6	3·3	
3	1st F. Node ..	5·6	7·3	
4	Plant height in cm. ..	45·9	54·3	
5	Total No. of internodes on main stem	18·4	19·3	
6	No. of fruiting nodes ..	12·8	12·0	
7	Shedding % ..	75·2	75·6	
8	Leaf length in cm. (A) ..	6·7	7·7	
9	Lobe length in cm. (B) ..	2·9	3·2	
10	Lobe width in cm. (C) ..	2·7	3·0	
11	Sciess-length in cm. (D) ..	3·23	4·7	

TABLE III (*Contd.*)

Sl. No.	Particulars	*Laxmi*	*Gadag I*	Remarks
12	Leaf index A/C ..	2·80	2·57	
	A/D ..	2·09	1·62	
	B/D ..	1·08	1·07	
	B/D ..	0·906	0·680	
13	Floral nectries:			
	(*a*) Leaf	Present	Present	
	(*b*) Within ..	,,	,,	
	(*c*) Without ..	,,	,,	
14	Boll length in cm. ..	3·63	3·90	
15	No. of loculi per boll ..	3·33	3·90	
16	Weight of kapas per 100 bolls in gm.			
	(*a*) 3 loculi ..	230	225	
	(*b*) 4 ,, ..	307	283	
	(*c*) 5 ,, ..	360	327	
17	Yield of kapas in lb. per acre	504	418	
18	Maturity % ..	78·0	70·0	
19	Picking period ..	Last week of Feb. to March end	1st week of March to March end	
20	Ginning % ..	36·0	33·0	
	HSWCs ..	42 *sh.*	33 *sh.*	
	Neps per yard ..	1·3	0·8	

CULTIVATION

In the Dharwar-American tract, cotton is a rainfed crop. In *rabi* tract of Ron and Gadag the *Laxmi* cotton is usually sown in the month of September. Preparatory tillage starts soon after the previous jowar crop is harvested or else after the first rains are received in April or May. One or two wooden ploughings are given and left for rains to break down the clods. Three to four harrowings are given for proper tilth. Direct application of farmyard manure to cotton at 5 cart-loads annually or 10–15 cart-loads in 5–6 years is usually done. Fertilisers are also being used at the time of sowing, or soon after sowing. The rate of application of fertilisers differ widely. Sowing is done during

September second fortnight by which time about 15 to 18 inches of rainfall is received. Sowing is usually done by drilling and using draw tubes behind the drill. About 8 lb. of seed are used per acre. The spacing between the rows will be either 21 in. or 2 ft. There are some cultivators who have taken up to hand dibbling and gap filling to maintain a good stand. Interculturings and hand weeding are given at an interval of about one month. In all, the cotton crop receives 3–5 interculturings and one or two had weedings. Interculturing helps to keep the fields clean from weeds and give a mulch to the soil.

In *kharif* tract of Ranebennur and Haveri Talukas, *Laxmi* cotton is usually taken as an intercrop with groundnut or chillies. Sowing is done in June or July. If it is taken as entire crop the sowing is done in August.

Present Problems with *Laxmi* Cotton

No doubt *Laxmi* cotton was a definite improvement over *Gadag I* but, during the course of its cultivation since 1950 it has suffered several set-backs due to various diseases, pests and climatic vagaries. Consequently there is a demand for the improvement of *Laxmi* cotton. A scheme sponsored by the Indian Central Cotton Committee, for the improvement of *Laxmi* cotton, is in operation at Gadag, since 1957. The object of the scheme is to improve *Laxmi* for its fibre qualities and at the same time incorporate resistance to certain diseases like red-leaf blight and black arm.

The line of work consists in (i) testing the interspecific crosses as they are found to be the only source of resistance to black arm diseases caused by *Xanthomonas malvaceranum*, (ii) testing material from within India and other foreign countries, (iii) suitable hybridisation with local material.

I.H.X. II—A selection from the interspecific hybrid, 170 Co_2, has been found to be promising and is now being tried in the district. Its performance is given in Table IV below:

Table IV

Comparative performance of Laxmi *and* I.H.X—II *strains*

Strains	Yield in lb. per acre (Average of 6 years)	Ginning percentage (Average of 6 years)	M. fibre length in inches	Fibre wt. per inch	Fibre irregularity %	Black arm grade (Average of 6 years)	Red-leaf blight grade (Average of 6 years)	Earliness by Bartlet's Index (Average of 6 years)
LAXMI	275	35·2	0·99	0·112	14·2	3·2	2·1	0·79
IHX–II	327	38·6	1·01	0·113	21·6	1·7	1·2	0·73

The exotic materials are usually low yielders.

There are several progenies in various generations of synthesis which are promising. These include the synthetic materials from Dharwar which are found to highly resistant to black arm disease.

With a help of another scheme for the Cotton Physiological Research, at Dharwar and Gadag, causes for low yields of *Laxmi* cotton and certain diseases like red-leaf blight and bad opening of bolls are being investigated.

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A BRIEF REVIEW OF THE RESULTS OF RESEARCH OBTAINED AT THE PADDY BREEDING STATION, MANGALORE

By P. N. Ananthakrishna Rao*

Introduction

The Paddy Breeding Station at Mangalore was started in the year 1944 and regular experiments were taken up from the year 1945. While the results of experiments conducted are presented in detail in the Annual Reports of the Department, it is considered desirable to present some of the useful results herewith for general information.

Evolution of Strains

In the case of the major rice varieties of the district, strains had already been evolved by pure line selection at the Research Station at Pattambi (now in Kerala State). Since the strains had been evolved under soil and climatic conditions rather different from those in South Kanara, their performance in this district was not quite promising and they were generally longer in duration than the ryots' bulk. Selection work was therefore started afresh in the case of the major varieties of the district, namely, *Kayama*, *Mascathy*, *Halluga* and *Athikraya*. Samples of the local varieties were collected from villages selected at random and work was started with about 500 plants in each variety. While assessing the performance of the new cultures, the corresponding strain evolved at Pattambi was used as the additional standard as the object was to evolve a strain higher yielding than that released from Pattambi. Though several cultures seemed most promising in the observation plots and even the preliminary yield trials, it became apparent from the very small number of promising cultures in the third year of yield trials that the evolution of a high yielding strain by pure line selection was largely a matter of chance.

Besides re-selection work in the major varieties in which strains had already been evolved at Pattambi, pure line selection was undertaken in the less important varieties like *Guddubolliari*, *Kanwa*, *Doddrai* and *Parambanavara*. In the case of *Kandrakkutty*, an important second crop variety, the best culture scoring nearly 20% over the local bulk did not prove itself better than PTB. 4, a strain closely resembling this variety and hence further work was kept in abeyance.

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The six strains so far evolved by pure line selection are,

MGL. 1 from variety *Guddubolliari* MGL. 2 from variety *Kayma* MGL. 3 from variety *Halluga* MGL. 4 from variety *Kanwa* MGL. 5 from variety *Mascathy*	..	First crop season
MGL. 6 from variety *Athikraya*	..	Second crop season

On the subject of evolution of a strain by pure line selection, opinion is divided whether the process of obtaining fresh samples in a variety and isolation of strains should be continuous or whether it should be discontinued once a strain has been evolved from the variety. Since high yielding cultures obtained in the course of pure line selection are believed to be either mutants or natural crosses (which have reached homozygosity after a series of years) and since securing such cultures is largely a matter of chance, it would be logical to include single plant selection in the different varieties as a permanent feature of the research work in a station because the chances of obtaining a better culture than the strain released are almost always present.

Trial of strains from outside the district.—The strains evolved by pure line selection are found to be distinctly better than the ryots' bulk from the point of view of uniformity but are not strikingly better in yielding qualities. Further, since they resemble the local varieties in morphological characters, they tend to get easily lost with the local varieties in the course of their spread. It is for these reasons that introduction of strains from outside the district has played a more vital role than the evolution of strains from local varieties.

At the time of opening of the research station, strains PTB. 9, Co. 3, PTB. 16, Co. 14 and GEB. 24 had already become very popular with the cultivators while strains like PTB. 13 and PTB. 11 which had been evolved from local varieties were found relegated to the background. Realizing the greater potentialities of improvement by introduction, the growing of about 200 types obtained from Coimbatore and other strains in each season and observing the desirable characters in each was adopted as an important line of research work at the station. Those which appeared promising were put under yield trials in the succeeding year and compared with the existing strain. The strains introduced into the district by this method are MTU. 3, MTU. 4 and MTU. 20 for the first crop season, PTB. 20 and Co. 25 for the second crop season and PTB. 10 for the third crop season, all of which are at present gaining in popularity.

Hybridization.—Two of the main problems in the district are lodging during the first crop season and the loss of viability of the seed

required for the second crop season. The following are the more important crosses effected during the years with the objects noted against each.

MGL. 1 × MTU. 3 PTB. 11 × MTU. 4	To induce non-lodging character in MGL. 1 and PTB. 11. A few cultures are under yield trials.
PTB. 20 × Co. 3 Co. 3 × culture 8448 Co. 3 × PTB. 19	To evolve a strain as high yielding as Co. 3 but not losing viability (Co. 3, a high yielder loses viability during the monsoon months). A few cultures are under yield trials.

The highly shedding character in *Kasipichodi* was attempted to be eliminated by crossing it with PTB. 9 which is so highly non-shedding that there is difficulty in threshing it. A few cultures are in observation plots.

Certain natural crosses of *Kavunginpoothala* with Co. 3 were isolated for evolving a Co. 3 type of strain which does not lose viability during the monsoon months. One culture, namely, Number 8360, has been found to possess the desired combination of characters and is under multiplication.

Certain progenies obtained by crossing Coimbatore and Aduturai strains with *Japonica* varieties are also under trial. A few progenies are found to be highly non-lodging during the first crop season.

The crossing of seeds during the first crop season is beset with great practical difficulty on account of the incidence of rainfall during the flowering period. Consequently, the initial number of F_1 seeds in each cross was only about a handful as against the minimum of "forty F_1 seeds from 12 female plants" suggested by Harrington (1959). The chances of obtaining the desired combination of characters which are ordinarily remote on account of the endless segregation met with in hybrid progenies are therefore rendered even more so.

The technique of hybridization appears to have played only a very limited role in the improvement of the paddy crop so far in most places. Out of the twenty-eight paddy strains released from a premier research centre like Coimbatore, only four are evolved from hybridization and even out of these four, only one strain, namely Co. 25, has attracted attention. This is largely because of the problem of segregation and the consequent difficulty in fixing the desired combination of characters unlike in a crop like sugarcane where certain hybrids have gained world recognition. The evolution of a strain by hybridization is also a slow process taking nearly twenty years.

Manurial Trials

The first manurial trial was laid out in the year 1947 when the efficacy of ammonium nitrate was compared with that of ammonium sulphate during the second crop season. Both the fertilizers proved to be on a par. Considering the explosive nature of ammonium nitrate, further trials with the fertilizer were discontinued.

An experiment to test the efficacy of the application of lime was started during the second crop season of the year 1948 and continued for a period of three years. The plots were kept constant for all the three years. Lime in the form of slaked lime was applied only during the second crop season (October–January) of each year but the residual effect was observed during the following first crop season. The lay-out adopted was the split plot with leaf at 4000 lb. per acre and 'no-leaf' as main treatments and lime at 0, 1000 lb., 2000 lb. and 3000 lb. per acre as sub-plot treatments. The application of lime at 2000 lb. and 3000 lb. with or without leaf resulted in significantly increased yields even in the first year of application, the increase in grain yield going up to 20% in the third year. At the 1000 lb. level, there was a significant increase in yield only from the second year onwards. There was residual effect only at the 2000 lb. and 3000 lb. level, the increase in grain yield being 8–10%. The pH of the soil rose from 6·21 to a maximum of 8·18 under leaf *plus* 3000 lb. lime at the end of the third year. The available phosphoric acid also increased with the doses of lime after the first application.

Efficacy of coffee husk as manure for paddy.—Since coffee husk is available in plenty in the coffee curing factories at Mangalore, an experiment was laid out in the second crop season of the year 1949 to compare the efficacy of coffee husk with that of green leaf at the level of 30 lb. nitrogen per acre. Coffee husk produced an increased grain yield of only 5·6% as against 27·5% by green leaf. There was no residual effect in the succeeding season.

Relative merits of cattle manure and green leaf as manures for paddy on an equal weight basis.—In the experiments laid out for three years from 1951–53 in single crop land to test the efficacy of phosphates, the relative merits of green leaf and cattle manure at 4000 lb. each per acre were compared by using these as main plot treatments. The results for the main plot treatments were significant and the following increases were recorded by leaf over cattle manure.

1951–52	34%
1952–53	17%
1953–54	10%

Efficacy of phosphatic manures.—In the trials conducted from 1950–53, superphosphate failed to produce significantly increased yield of grain even at the level of 45 lb. P_2O_5 per acre in the first two years while bonemeal at this high level alone produced increases of 20–25%. The excess of iron and alumina in the soil possibly interfere with the utilization of phosphates particularly those with an acidic reaction like superphosphate. The results in the third year were not significant. In the fourth year, however, superphosphate was on a par with bonemeal in effectiveness and significantly higher yields of 12–20% resulted even at the 30 lb. level of P_2O_5 under both the manures.

Supply of phosphate to paddy through the medium of a green manure crop.—Phosphoric acid at 30 lb., 45 lb. and 60 lb. per acre was supplied to the paddy crop as follows:

(1) Directly applied before planting, (2) applied to the green manure crop (Kolingi—*Tephrosia purpurea*) preceding the paddy crop. There was no difference in the efficacy of the two methods, there being no increase in yield in either case.

Comparative merits of ammonium sulphate and Chilean nitrate as manures for paddy at levels of 40 *and* 60 *lb. nitrogen per acre.*—The trial was conducted for three years from 1952–54. Applied alone, the fertilizers almost consistently produced less grain yields than the basal dressing of 3 tons of cattle manure, 450 lb. lime and 30 lb. P_2O_5 per acre. Applied over the basal dressing also, the fertilizers at both the levels failed to score over the control (basal dressing alone) in the first two years and in the first crop season of the third year. In the second crop season of the final year, however, ammonium sulphate at 40 lb. and 60 lb. nitrogen over the basal dressing produced respectively 23·4 and 29·1% significantly increased yields over the control while in the case of Chilean nitrate, a significantly higher yield of only 14% was recorded at the 60 lb. level of nitrogen.

Cultural Trials

The nursery for second crop can be sown either early in August when the seeds are sown in wet nursery but continued later on as dry or in the second or third week of September when the nurseries are maintained as wet. The main advantage of the semi-dry nursery is that the seedlings can be kept in the nursery for an indefinite period up to even three months without their forming nodes and further that the maturity of the crop is advanced by about ten days which can prove highly advantageous. It is believed, however, that the seedlings from the later sown wet nursery give a better crop. The first cultural trial

was laid in the year 1946 when the performance of the important strains under these two systems of sowing was compared. The conclusions arrived at under the limited water resources at the station were that the semi-dry nursery was more advantageous in the case of strains PTB. 16, Co. 25 and the local variety *Kandrakutty* while the wet nursery was more advantageous with strains like Co. 3, Co. 14 and PTB. 19. With PTB. 4, the differences were negligible.

Japanese method vs. *the existing 'farm' method.*—In the replicated trials conducted from 1953–55, the increase in grain yield under the Japanese method was significant by 9–17·0% over the farm method. The increase in straw yield was even over 50·0% in two years. From the economic point of view, the Japanese method may not be advantageous to the farmer who depends on paid labour.

The main points of difference between the Japanese and the 'Farm' method are that in the Japanese method, the nursery is sown at a thin seed rate, manured heavily and transplanted when 25 days old; the seedlings are planted 10″ apart in lines and interculturing is done with the rotary weeder at periodic intervals. As regards heavy manuring, the Department is freely advocating the application of 40 lb. nitrogen per acre and is experimenting with a dose of 60 lb. nitrogen per acre. Hence heavy manuring cannot be considered as exclusive to the Japanese method but the application of phosphate as top dressing may be taken as a special feature which is justified since it gets incorporated into the root zone in the course of interculture.

In this district where nurseries are sown dry during the first crop season with the help of only the summer showers, the scope for the application of fertilizers to the nursery is limited indeed. Further, heavy manuring makes it necessary for the seedlings to be planted out when about 25–30 days old as they would otherwise form nodes and become unfit. With the break of the monsoon being so erratic and unpredictable, it may not be sound practice to take chances with a nursery that must be planted in about 25 days. During the second crop season also, the time of planting is unpredictable as first crop harvests depend on the weather and the availability of labour.

Instead of testing the Japanese method in its original form, it may perhaps be far more useful to test the efficacy of each of its main features which may be applicable to this district, namely, thin sowing of nursery, method of planting with modified spacings and interculture. With this object in view, modified experiments have been started to determine the usefulness of line planting, the optimum spacing and the role of nterculture as also a combination of these.

Earthing-up of Paddy.—The main feature of this method is that the rows are earthed up on the 15th and 25th day after transplanting by drawing soil from either side. The trial was conducted during the first crop seasons of three years from 1956–58. Though there seemed to be less lodging in the plots under the above method, the differences were not significant. It may be worth-while repeating the experiment again with the first earthing up done a month after planting and the second a fortnight before flowering so that the plants may get support when they need it most instead of at too early a stage.

4. Entomological Studies

Incidence of "paddy Gall-fly".—From the trials laid out with strains MGL. 1 to MGL. 5, PTB. 9 and MTU. 3 during the first crop seasons of 1955 and 1956, the indications are as follows:

(i) Strain MGL. 1 is comparatively resistant.
(ii) Incidence is proportional to tillering.
(iii) Drainage does not influence pest attack.

5. General

The special difficulties encountered in laying out field experiments, particularly manurial experiments in the district of South Kanara, are the incidence of heavy rainfall during the first crop season and the limited supply of water during the second crop season resulting very often in a partial drying up of the plots and the vitiation of results. It is becoming evident more and more that the results of experiments can differ sharply from year to year and from place to place within the same region. No rigid recommendations are therefore advisable. The most desirable policy might be to educate the cultivators to take the results from research stations as a guide for laying out similar trials in their own fields to determine the most suitable varietal, manurial and cultural combinations for their particular conditions.

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NOTES AND NEWS

THE Young Farmers' Rally that was hatching in the minds of a few enthusiasts was held in the month of February, 1959; and it was a signifidant event inaugurated by the Prime Minister of India, Pandit Jawaharlal Nehru. Quite a number of programmes were arranged giving the event a Young Farmers' touch, the Presentation of the Flag, the March Past, the Floats, etc. As the "*Deccan Herald*" has observed in its Editorial, though the Young Farmers' programme is not new to Mysore, the inauguration by the Premier was indeed a new impetus given to it. A critic would still find a number of points, training, age, attitudes and other factors to question; and on this score, the getting through of a rally, was a great satisfaction to the organisers. A programme centering mainly round a Seminar or a Conference or a Course of lessons would make it difficult, while items of amusement by themselves would not give a full meaning to the event. It is in being able to spot out those parts of the programme which could specifically be associated with Young Farmers that marked a step in achievement in the opinion of the organisers.

One would have liked to see a greater number of the younger group of Young Farmers participating, but if the seniors are sufficiently tutored to see to it the Rally has indicated that they can enthuse the youngsters and the resources may permit the required orientation in future.

"Learning by doing" was raised to a status of more than a slogan by the enthusiastic President of our Young Farmers' Association the Minister of Agriculture, Mysore, prescribing that the delegates to the Rally produce a certificate from the local organisers that each of them had put up a compost pit in his place. The delegates were more conscious of this requirement than the organisers themselves and it was a very pleasant event to see them carefully handing their certificates along with their delegate fees.

The Exhibition held in connection with the Rally was also designed according to Young Farmers' requirements. Stalls were allotted to the organisations pertaining to each district. Many of the exhibits pertained to the projects handled by Young Farmers and sample records kept by the clubs was also on the show. That these stalls should be predominant in the Rally exhibitions, that they might be attended by a considerable number of representatives of clubs, that judging rings,

show enclosures, etc., might occupy more of the Exhibition grounds is a picture for the future, of which the Rally has shown indications.

That ploughing and other competitions were held at the grounds of the Agricultural College was also a very desirable feature. The college, one feels, should in fact be more intimately connected with the Young Farmers' Movement and should invite the Young Farmers' Association to hold its annual rallies at the college. Most of what is new in Agriculture one would naturally expect to proceed from the college and the students and the faculty of the college are in fact a part of the people and have a mission in the line of Agricultural Extension and absorption and dissemination of new ideas.

Over 2,000 delegates from all parts of the Mysore State attended the Rally and even if it be that some more popularising of the movement may be necessary, one can hopefully expect that the message has been carried the country over. That it has been possible to secure the participation of the Vice-Chancellor of the Mysore University in the Rally celebrations implants the hope in the hearts of the sponsors that an extended interest of the seniors in the University and the Juniors in the Educational Institutions will be evinced in the movement, as it developes.

If one were to look for a message to be carried into the future programmes it is the call of the co-operative effort specially highlighted by the Premier's inaugural speech. There have indeed been controversies on certain aspects of it but there seems to be no doubt that there is a vast field in this direction to be covered by the Young Farmers and it is a field that indents on skill as well as love.

—*Secretary.*

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